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## DEVONIAN FISHES FROM CALIFORNIA

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### ABSTRACT

The first occurrence of the well-known dinichthyid arthrodire *Dunkleosteus*, represented by disassociated and weathered bones, in the Quartz Spring Sandstone Member of the Lost Burro Formation (Late Devonian) in Inyo County, California, is reported. Of particular interest is the presence of teeth of cladodont and cochlodont sharks together with the *Dunkleosteus* bones.

This notice reports an original finding of weathered, disassociated remains of Devonian fishes from California. The specimens were collected by one of us (N. G. L.) north and 100 feet above the road passing through Lost Burro Gap (lat. 36° 44' 59"; long. 117° 31' 19", northeast corner of the Ubehebe Peak 15' quadrangle, Inyo County, California). The specimens were obtained from thin-bedded cherty limestone and calcareous to dolomitic sandstone in the upper 20 feet of the Quartz Spring Sandstone Member of the Lost Burro Formation. This member constitutes the *Cyrtospirifer* Zone of MacAllister (1952) and a late Upper Devonian age has been indicated by studies of invertebrate fossils (Langenheim and Tischler, 1960), and conodonts (Youngquist and Heinrich, 1966). This age can now be corroborated on the basis of the presently noted vertebrate fossils.

The recognizable remains, deposited in the paleontological collections of the Cleveland Museum of Natural History, include two fragmentary elements of the dermal armor of a moderately large

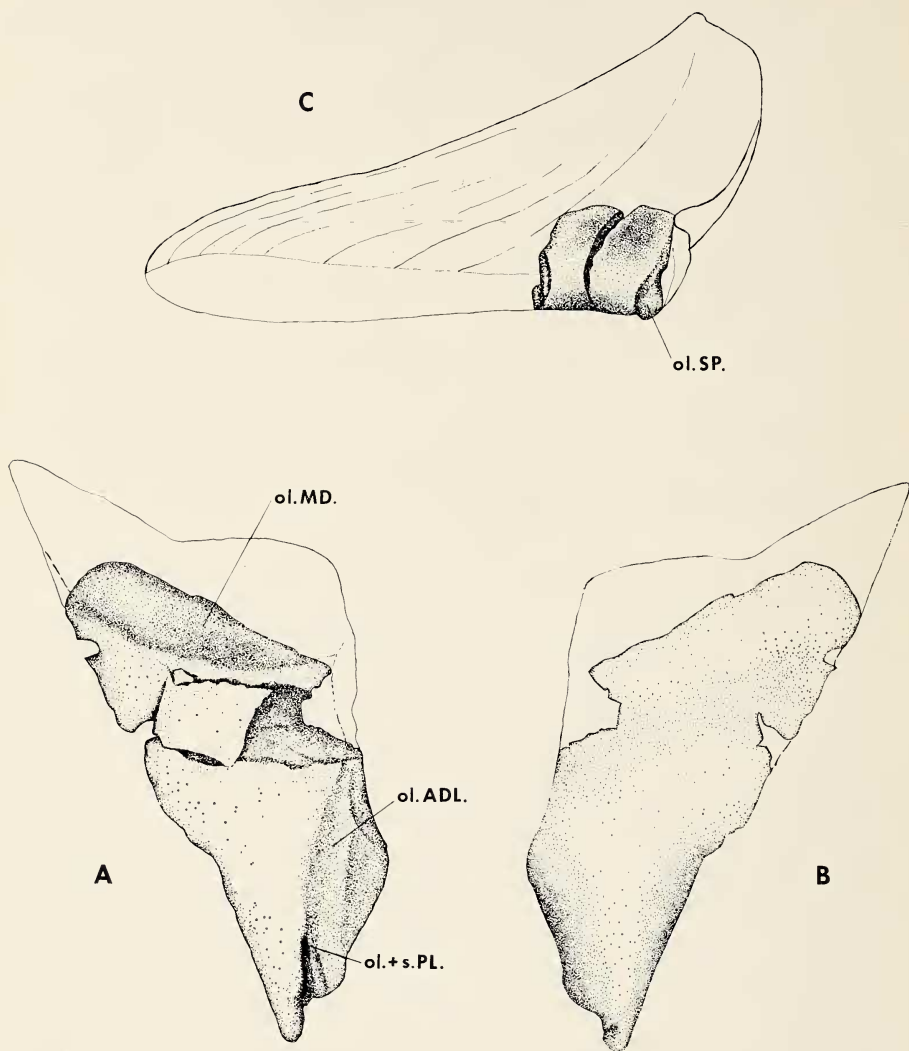


Fig. 1. Bones attributed to *Dunkleosteus terrelli* (Newberry) from the Quartz Spring Sandstone Member of the Lost Burro Formation (Late Devonian) in Inyo County, California. Sketches, as preserved, of right posterior dorsolateral plate (CMNH 8231) in (A) external and (B) internal views and left interolateral fragment (CMNH 8232) in (C) anterolateral aspect. Reproduction approx.  $\times .45$  natural size. Abbreviations: ol. ADL, overlap area for anterior dorsolateral; ol. MD, overlap area for median dorsal; ol. SP, articular facet for spinale; ol. + PL, overlap area and sulcus for posterolateral.

placodermatous fish and the teeth of a shark and of a cochliodont. The placoderm bones are readily identifiable as the right posterior dorsolateral (CMNH 8231) and the left interolateral (CMNH 8232) plates of an arthrodire. In fact, comparative details of structure are so closely similar that the bones cannot be distinguished from the corresponding elements of the distinctive and well-known dinichthyid *Dunkleosteus*. The materials are illustrated (fig. 1) imposed on the outlines of appropriate bones of *Dunkleosteus terrelli* (Newberry) from the Ohio Shale. For present purposes further description is unnecessary.

The shark tooth (CMNH 8233), typically cladodont although generically indeterminate, is a relatively small example and consists of an expanded root having rounded extremities and a width almost equal to its length. The cross section of the principal cusp displayed is robust and although a little flattened or slightly concave on its labial side is without either lateral keels or vertical striation. A single pair of diminutive lateral accessory cusps is indicated. The recognized cochliodont nature of the other tooth (CMNH 8234) is based on the histologic structure of a basal layer of osteodentine and a superficial layer of tubular dentine whose parallel canals perforate the convex coronal surface perpendicularly.

Despite a lengthy awareness of the collective nature of the arthrodiran genus *Dinichthys* only a few of the indicated revisionary studies of the many species either originally or secondarily attributed to it have been made. Among those accomplished, however, Lehman's (1956) removal of three forms (*Dinichthys terrelli*, *D. intermedius* and *D. curtus*) (see also Eastman, 1907 and Dunkle and Bungart, 1940, 1946) from the Upper Devonian Ohio Shales to a new genus, *Dunkleosteus*, is of pertinent interest in the present connection. The combination of structural characteristics which distinguish *Dunkleosteus* from all other arthrodiran associates have been elaborated, especially by Heintz (1932), in detail. Of these and prompting this similar generic allocation, the new materials from California display the same overlap plus ingrown dentation of the sutural articulation between posterolateral and the posterior dorsolateral bones. Also, the interolateral presents the similarly shortened ventral lamina and the well-defined articulatory facet preserved laterally on the ascending lamina denoting the retention of a greatly reduced spinal element which among the presumably closely related dinichthyid assemblage is a unique feature of *Dunkleosteus*.

*Dunkleosteus* is best known for numerous remains and many individuals showing great variation in size in certain strata, notably the black Ohio Shale (Famennian) of Ohio and Kentucky, equivalent levels of the New Albany Shale in Indiana and north-central Kentucky and the Chattanooga Shale of Tennessee. Some fragments wholly reminiscent of the genus and possibly reworked into the basal Mississippian have been reported from Texas (Dunkle and Wilson, 1952). In addition, other species from the Upper Devonian of Morocco (Lehman, 1956) and of Europe (Obruchev, 1964) have been referred to *Dunkleosteus*. It is probable that future studies of other dinichthyid species (notably *D. magnificus*, Hussakof and Bryant, 1918, from the Rhinestreet Shale, *D. missouriensis* Branson, 1914, from the Grassy Creek Shale, among others) may prove to have the same generic affinity but at the present time no very great extension of the temporal distribution of *Dunkleosteus* can be projected.

The finding in California of these fishes, all representative of marine lineages, is not only of considerable paleogeographic importance but, in view of the meager available record of Devonian cochliodonts, is definitive of an interesting and, as yet rather uncommon, faunal association.

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